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A PRELIMINARY SURVEY OF MAIZE IN THE SOUTHWESTERN UNITED STATES¹

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Maize is uniquely variable; differences from plant to plant, from variety to variety, and from region to region are even greater than in other cultivated plants. Previous papers by Anderson and his collaborators (Anderson and Blanchard, '42; Anderson and Cutler, '42; Kelly and Anderson, '43; Anderson, '43a, b, '44a, b) have discussed the means of cataloguing this variation most effectively. They have recorded it in detail, character by character, and have described a few of the races and sub-races which are already apparent in our collections. The following paper is an attempt to classify the maize of the southwestern United States, particularly the varieties grown by the Indians. While it is more comprehensive than any previous attempt, we consider this a preliminary report since it raises many more questions than it answers, and of these, many should yield to further investigation.

Maize is also unique for purely technical reasons in its excellence for both cytogenetic and archaeological investigation. For cytogenetics it has the initial advantages of many readily available unit characters such as starchy vs. sweet kernels; green leaves vs. purple leaves. For cytological analysis it has the advantage of long, well-differentiated chromosomes. To these original advantages has been added by cooperative research a wealth of detailed technical information unparalleled for any other plant (see Rhoades and McClintock, '35). Archaeologically, maize has the advantage of its large indurated ear which resists decay and which presents almost as many significant characters for racial diagnosis as does the human skull. Therefore, when cytogenetic and archaeological informations are merged we may expect eventually a more complete, detailed, and significant history than is possible for any other cultivated plant or any domesticated animal. Such a synthesis would be useful to geneticists, archaeologists, corn breeders, geographers, ethnologists, and culture historians.

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For a number of reasons the classification of southwestern maize is a relatively simple problem; simple, that is, by comparison with modern commercial maize or the maize of Central America or of South America. Since the beginnings of its agriculture the Southwest has been semi-isolated from other agriculturally developed areas by geographical and climatic factors, and interchange with other areas has been comparatively slight. Within the region itself, maize growing has been strongly localized by climatic conditions; i. e., in contrast to Mexico or Guatemala fields were few and far apart, giving opportunity for the development of well-differentiated local varieties. Compared to most areas, the Southwest is well known ethnologically and archaeologically. Modern and prehistoric maize is already on hand in museum collections² in considerable quantity while in practically any other area one must first assemble his own collections. We have artificially simplified the problem even further by leaving out the question of sweet corn. It is grown by a number of southwestern tribes (most particularly by the Hopi), but as Kelly and Anderson have pointed out ('43), the origin of sweet corn is a rather different problem technically from the origin and development of dent and flour corns. The whole question of sweet corn in the Southwest is therefore postponed for further publication.

Unfortunately, collections of modern maize need to be made with extreme care if they are to be of maximum usefulness. Maize is a very sensitive mirror of the people who have been growing it. Collections made from Indians living along concrete highways or in the suburbs of modern American towns will be faithful reflections of the extent to which they have left their old ways. A progressive Papago Indian who owns a small truck and lives on the highway between Sells and Tucson will have seen various kinds of maize in the course of his work and may bring back a good many to try out in his corn field. While most of them may not be well suited to these peculiar desert conditions, if they survive even for one season, the wind may carry their pollen to other plants and a new element will have been introduced into this particular cornfield. Yet the ordinary collector will be satisfied with Papago maize from such a source and will not press on over the long dry road to Sells and then go farther still on side roads into the reservation to find Papago maize which shows no evidence of Yankee contact, none of Spanish contact, and very little contact with other Indians. Yet such maize was characteristic of Papago communities as late as 1943. To some students who have collected maize in the Southwest an Indian was an Indian, and the idea of spending an extra day or an extra week in reaching a seed source of unimpeachable significance seemed a waste of time and effort in a country where travel was difficult. Even those who understood these matters were impeded by the practical necessity of getting back to their base of supplies. The very slight literature on the maize of the southwestern Indians is therefore shot through with information which is only partly true and which would need the joint services of an agronomist and an ethnologist to interpret correctly.

² As, for instance, the remarkable collection assembled by Volney Jones and A. F. Whiting at the Museum of Northern Arizona (See Whiting, '39).

A number of facts are apparent from figs. 3 to 20:

1. The maize of the desert Indians (Yuma, Mohave, Cocopa, Pima, Papago) is comparatively uniform and essentially similar. It is not very different from the maize of the widely distributed prehistoric Basket-makers.
2. The maize of the pueblo-dwelling Indians is much more variable both as to the varieties grown by a single tribe and as to differences between tribes. In general, the maize of the eastern Pueblo people is much more Eastern-like than that of the western Pueblos.
3. Of all the Pueblos, the maize of the Hopi shows the least Eastern influence. Some of it is almost identical with Basketmaker maize. As a whole, it is rather like such corn which has been strongly influenced by the Mexican complex.
4. Zufi maize is much like Hopi, but in our admittedly incomplete collections it lacks the Basketmaker-like varieties.
5. The Keresan Pueblos are all very similar and grow a type of maize which is roughly intermediate between the Pima-Papago and the eastern Pueblos. They might well have derived a good deal of their corn from the Hopi, an impression which is strengthened when the color is also considered.
6. The eastern Pueblos, considered as a whole, have about the same amount of Mexican complex as the Keresan, but show much more Eastern influence. As a whole, they are far from uniform and each one presents certain special features. By pueblos these are as follows:

San Ildefonso.—This pueblo shows a strong "Spanish" influence. This is not surprising since it is practically in the outskirts of the old Spanish-American town of Santa Fe. When the ears of our collections from the pueblo and from Santa Fe are laid side by side there can be little doubt that the San Ildefonso maize has been extensively mixed with that from the Spanish community near by.

Isleta.—With the exception of a few ears of maize, our collections from this pueblo are very similar to those from the western Pueblo area. This is to be expected since it is known that this pueblo took in a considerable number of Keresan-speaking refugees. Mrs. Parsons reports that clan structure shows resemblances to both Keresan and Tewa. Considering its location and its history it is therefore to be expected that the Isleta maize should include both types.

San Juan.—This maize is all very much alike and all similar to that from Mexican villages. This, too, is what might have been expected. The site of the first Spanish settlement in the Southwest, San Gabriel de los Españoles, is just across the river. The mission was succeeded by a little Mexican town, "Chamita", which was unfortunately on the right-of-

ductions of corn types are probable.

In each of these preceding periods there was some expansion outward from the central area in the "Four Corners" region. This expansion reached its maximum between 900–1100, Pueblo 2. People related to the Pueblo (Anasazi) culture then extended from southeast of Flagstaff, Arizona, nearly to Salt Lake, and in the latitude of the Grand Canyon reached from the Rio Grande to the Colorado. There was considerable regional variation. Large, many-roomed pueblos were already being built in the Chaco Canyon, the people of Mesa Verde were living in small masonry houses, while pit houses remained in use near Flagstaff. In all areas, however, the people were fully sedentary agriculturalists.

From the very beginning these people had been occupying a distinctly arid country and raising crops by dry farming. They must, therefore, have started with highly specialized crops. By locating their fields advantageously in reference to soil, run-off, and higher elevations with their greater precipitation they succeeded for hundreds of years in raising crops in areas considered impossible for modern agriculture.

In Pueblo 3 (1100–1300) a shrinking of the occupied area became apparent, and the settlements of small villages of loosely grouped houses now became compact towns of considerable size which were often built in defense locations. Houses were built wall to wall, several stories high, and entrance to first-floor rooms was normally from the roofs and not from the exterior ground level.

The attempted explanations for these happenings are still unreconciled. They fall into three categories. One theory points to climatic changes; another points primarily to the effects of invasion of nomadic peoples; a third to soil exhaustion and erosion. A variant of the second calls attention to the effect of warfare between the various Pueblo peoples.

That the distribution of corn types fits both the linguistic grouping and geographic position has already been pointed out. This may either imply that the various linguistic groups brought varying races of corn or that their geographic position in the Southwest gave them greater or lesser opportunities to get new varieties of corn. In view of the conservatism of the people, the high degree of adaptation of some of the earliest corn types, and the sudden appearance of new races of corn in special areas (e.g., dent corn of extreme Mexican type in the Northern Periphery), it seems fairly possible that the various linguistic groups represent different immigrations of people, each of which brought new agricultural material. The time of these introductions is not yet established, but further research now under way may do much to clarify this.

Perhaps a movement of peoples is implied in the first appearance of corn in the Four Corners region. Clearly, there were further introductions of corn types, between Basketmaker and Pueblo times. Whether other introductions occurred in the 600 years between Pueblo 1 and the "great drought" of 1300, or whether the next importation of corn came with peoples unsettled at the time of the "great drought" is not yet clear. It is even quite

possible that some of the corn types limited to the upper Rio Grande pueblos are post-Spanish, for after the Pueblo revolt some of the people are known to have fled into the Plains. It is not unlikely that some of these people later returned to the Rio Grande bringing new maize varieties with them, e.g., to Tesuque.

It is clear from the above that the development in the Anasazi area was a very complex affair involving different peoples and cultures. The cultural evidence suggests that in the thousand years after the introduction of agriculture there were repeated movements of people into the area. The implication of multiple introductions is particularly strong in the languages represented.

We are quite clear on the fact of multiple introductions of corn into the Pueblo area. We are sure of separate corn varieties appearing in Basketmaker 2 and again in the Basketmaker 3-Pueblo 1 periods; thereafter we can not yet place the time of arrival of the various races of corn that are modernly represented in the Anasazi area. Further work will surely make this possible.

The other basic culture of the Southwest to be considered here is the Hohokam. It is both less well known and less complex. Our knowledge concerning it begins about 600 A.D. according to Gladwin ('42, p. 4). At this time it seems already to have been a developed culture with agriculture and pottery, hence its true beginnings must go back of that date. The people lived in loose villages and occupied the middle Gila and the Salt River valleys, areas utilizable in their lower parts only by irrigation, whether from arroyo flooding or by using the waters of major streams. True canal irrigation was developed very early. Although we know less of this culture than we do of the Anasazi sequence, the evidence to date shows no such complexity in development as is found on the plateau. Culture periods are discernible but in the main they seem the result of local development with little outside influence until very late in their history.

The great problem of the Hohokam centers on their survival. After the mid-14th century the record becomes very incomplete. When the Spanish arrived they found the Hohokam area occupied by the Pima-Papago peoples. These latter were, and remain, village-dwelling farmers retaining the old Hohokam crops and some irrigation. The agricultural evidence suggests that they may be (at least in part) the descendants of the Hohokam.

A great contrast runs throughout these two cultures. The Anasazi developed into town-dwelling peoples with a tradition of masonry houses; they specialized in dry farming, developed elaborate rituals for rain, and had distinctive pottery techniques, etc. Their culture was complex, perhaps partially because of the different elements entering into its make-up. The Hohokam remained village dwellers with little evidence of alien peoples or cultures influencing them. They very early developed irrigation and established an elaborate ditch system in the Gila and Salt valleys. In religion, art forms, specific crops, and many more details they differed markedly from the Pueblo peoples.

This contrast is clearly reflected in the corn of the Southwest. Pueblo corn is complex in its make-up. It changes from period to period and to-day varies

throughout the Pueblo area. By comparison with the maize of other native areas, Hohokam maize is extremely uniform, probably one of the most uniform races one will ever find under primitive cultivation. It seems to have changed little in the past thousand years.

One of the crucial points in the relation of the Anasazi and the Hohokam revolves around the relationship between Basketmaker corn and Hohokam corn. We know Basketmaker corn from its preservation in the dry caves of the Southwest. It is closer to the Hopi and the Pima-Papago corn of to-day than it is to the maize of the Rio Grande pueblos. Some of the strains of Hopi corn fairly represent late Basketmaker corn. Hohokam corn is known from the published reports of the Snake Town plant materials (Castetter and Bell, '42), and from Haury's excavations in Ventana Cave (paper in press, 1944, but we have examined the maize remains). It is close to, though not identical with, the corn grown to-day by the Pima and Papago Indians. We have therefore a distinct race of corn in the Southwest that is common to the two different cultural areas at the earliest levels and which survives in part among the westernmost of the Puebloan peoples and among the desert-dwelling peoples who are presumably the descendants of the Hohokam.

We have not yet photographed and measured all the prehistoric North American corn available in museums and private collections. Until that job has been done an extended discussion is premature. However, from the prehistoric maize we have already seen and the junior author's studies of modern Mexican maize, it seems probable that there were at least three waves of prehistoric maize in North America. The first was a small-cobbed, small-seeded, tessellated, compressed, undented race. It survives to-day in its purest form in the maize of the Pima and Papago. It can be seen only slightly mixed in the early varieties of the Pawnee and other Missouri River Indians, in old varieties from the Gaspé Peninsula in Canada, and in *Maíz reventador* and related varieties from western Mexico. Its presence in Oaxaca, Mexico, in 400 to 600 A.D., is suggested by the representations of maize on the funerary urns of the Zapotecs, which resemble Basketmaker maize more closely than they do the modern varieties of Oaxaca. It is one of the types recovered from mounds and other archaeological sites in the Mississippi Valley (where it is apparently one of the earlier types to appear, though the evidence is not consistent on this point). The other two waves we have already described as "Mexican" and "Eastern." In later papers we hope to be able to work out the order of their appearance and perhaps ultimately to trace them back to their origins.

SUMMARY

1. The technical advantages of *Zea Mays* for cytological, genetical, and archaeological study are described. It is concluded that when we eventually combine the information from these three disciplines we shall have a more complete picture of maize in space and in time than will ever be possible for any other